MECHANICAL SORTING OF CINCHONA SEEDS 1)

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Author's summary

The usual method of grading cinchona seeds in transmitted light was criticised and found unreliable. It was replaced by a method of mechanical sorting.

In Mededeelingen van het Gouvernements Kina Proefstation (Bulletin of the Government Cinchona Experimental Station) No. 8, on the germination of Cinchona-seeds, Kerbosch has described a method of sorting Cinchona seed on a glass table with transmitted light. This sorting is done "to clean the seed by sorting out parts of the capsule and axial column, unripe and over-ripe seed". Quoting Van Leersum further Kerbosch says:

"This so called sorting of the seed is one of the most important things to be attended to, and it can be done best by women, who soon get a certain skill and learn to distinguish accurately the colour of good ripe seed from bad seed. The advantage of transmitted light is that the parts of the seed (wing, kernel and germ) can be seen separately, and seeds showing abnormalities in kernel or germ, can easily be recognised and sorted out by transmitted light. Reflected light allows only judging of the seeds as a whole according to colour and size."

At the end of 1939 2.077 grams of *Cinchona* seeds had to be sorted at the West Java Experimental Station, Buitenzorg, Java, and the method of transmitted light was chosen. Ten cases of about 18×24 inches, with inside illumination, and covered with milk-glass were made, two women working at each case.

Some of these women were thoroughly experienced in sorting cinchona seed, having done this for years at the Government Cinchona Estate, Tjinjiroean.

During this sorting the accuracy of the method was doubted. The women did not appear to judge the kernel and germ of each seed separately and so remove the abnormal seeds. They appeared to be merely sorting on size. It seemed clear that the women had no sharp criteria when judging a seed. Judging a seed as a good seed seemed to depend more or less on chance. Therefore I tried two methods to check this and both proved that there was no question of criteria at all.

In the first method a certain amount of seed, enough for a day's sorting, was given to two women working together at the same table. At the end of the day the seed was received back in two portions, one "good" seed and the other "waste" seed. The next morning the portion of "good" seed of the previous day was given in another container to the same women. They never brought it back immediately to say that it had already been sorted but always sorted the "good" seed of the previous day into two portions, "good" and "waste" seeds. The test was repeated several times with always the same result.

¹⁾ Received for publication December 1, 1952.

The second method to get an impression of the reliability of the method of transmitted light was as follows:

A certain quantity of unsorted seed was weighed and given to the two women, working at the first table. After sorting, the quantities of "good" seed and of "waste" seed were weighed, after which they were mixed together again and given to the women of the second table the next day, and so on. In this way the same lot of seed was sorted ten times by ten different couples. The test was repeated with another lot of seed, this was sorted nine times. The results are given in Table 1. They are arranged in order of the amount of "good" seed. The small differences in their total weights are due to drying out on the glass plate during sorting and to the up-take of water during saving the seed overnight.

Table 1.

Total seed g	Good geed g	Waste seed g	good seed	% waste seed	Total seed g	Good seed g	Waste seed g	good seed	% waste seed	
5.12 5.02 5.10 4.99 4.96 5.06 5.01 5.04 5.01 5.12	2.92 2.87 2.74 2.61 2.45 2.36 2.30 2.10 1.92 1.68	2.18 2.15 2.36 2.38 2.51 2.70 2.71 2.94 3.09 3.44	57 57 54 52 49 47 46 42 38 33	43 43 46 48 51 53 54 58 62 67	12.32 12.26 12.56 12.46 12.38 12.38 12.52 12.40	7.91 6.98 6.35 5.95 5.78 5.53 4.67 4.53 4.24	4.41 5.28 6.21 6.51 6.60 6.85 7.85 7.87 8.17	64 57 51 48 47 45 37 37 34	36 43 49 52 53 55 63 63 66	
Mean		_	47.5	52.5	-	-	_	46.7	53.3	

From these results it is clear that sharp criteria for the judgment "good" or "bad" are entirely lacking.

"Good" seeds were heavier than "bad" seeds, and showed in germination tests a higher germination percentage. But the germination tests showed too, that, due to a greater number of seeds per gram, waste seed had as much viable grains per gram as good seed.

In 1947, when some 8.000 grams of seeds of *C. ledgeriana* and 2.000 grams of seeds of *C. succirubra* had to be sorted, we constructed a winnow to clean the *Cinchona*-seeds mechanically. With a stopwatch we found the time a *Cinchona*-seed needs to reach the floor falling free from a height of 2 metres. From the differences in time it was clear that it might be possible to separate the good seeds from dirt, parts of the capsules and spongy seed in a rather slow current of air. We built a tea winnow on a reduced scale and after some experience with a pilot model we decided on the following dimensions:

Height 2 metres Length 3.60 metres Width 0.30 metres

Through this tunnel, a current of air was sucked by a fan mounted at the

end of a funnel-shaped sheath of 1.45 metres which made an air-tight joint with the back of the tunnel. The speed of the air in the tunnel was about 20 metres per minute; by closing a pair of doors at the front the speed of the air at the entrance of the tunnel could be regulated and speeded up to 60 metres per minute. This temporary higher speed of the air at the beginning gives a higher horizontal speed to the seeds at the moment they fall into the current of air and results in a better separation. The seeds fell into a tunnel through a funnel with a vibrating plate underneath; the supply of the seed could be regulated by a sliding lid.

After falling, the seeds were collected in six drawers in the bottom of the tunnel, the heaviest seeds in the first one, the lightest seeds in No. 6. Germination tests with those winnowed seeds showed a good correlation between the number of seeds per gram and the germination energy ²). Some of the results are compiled in Table No. 2.

Table 2.

Variety	GA. 14	KP. 279		Tjib. 5		KP. 106		KP. 19		Succirubra	
No. of seeds	Germ.										
per g	energy %										
2509	94	2290	94	2780	96	2680	100	2864	98	2233	96
3243	90	2580	94	3120	94	2760	97	3000	97	2476	93
4382	83	4594	66	3250	87	3260	96	6640	53	4328	68
10362	3	9365	1	5800	23	8750	3	12200	0	—	—

In practice the winnow turned out to be quite satisfactory. One man could easily operate the machine. As a rule the seed was winnowed twice, the first time the greater part of the spongy seed, parts of the capsules, dirt, etc. was removed. The seed of the first three drawers was then winnowed a second time. The capacity was about 250 grams of good seed a day; equal to the achievement of 200–250 women, sorting seeds with transmitted light. The ratio of good seed to waste seed was, by mechanical sorting, considerably higher than by hand sorting. Hand sorting gives 25–45% good seeds, mechanical sorting, 85–95% good seeds. The cost of mechanical sorting was 99% lower than of hand sorting. For example: a quantity of 2.000 grams of C. succirubra seeds was sorted into 1857 grams good seed (germination energy 93%), husks, dirt, etc., 52 grams, waste seed 62 grams, losses of humidity in the dessicator 29 grams.

REFERENCES

Kerbosch, Dr. M.: Het kiemvermogen van kinazaden. Mededeelingen van het Gouvernements Kina Proefstation, 13 (1920) 14–15.

²⁾ Germination energy is % germinated seeds within 20 days, apparatus according to Kerbosch.